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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Graham BANK et al.

Title: MOBILE TELEPHONE

Appl. No.: 10/005,367

Filing Date: 12/07/2001

Examiner: Unassigned

Art Unit: 2681

CLAIM FOR CONVENTION PRIORITY

Commissioner for Patents
Washington, D.C. 20231

Sir:

The benefit of the filing date of the following prior foreign application filed in the following foreign country is hereby requested, and the right of priority provided in 35 U.S.C. § 119 is hereby claimed.

In support of this claim, filed herewith is a certified copy of said original foreign application:

- GREAT BRITAIN Patent Application No. 0114501.0 filed 06/14/2001.

Respectfully submitted,

Date JAN 29 2002

By _____

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Signed J Evans.

Dated 12.12.2001

14JUN01 E637303-1 D02824
P01/7700 0.00-0114501.0

Patents Form 1/77

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The Patent Office

Cardiff Road
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1. Your Reference

P.6692.GBA

2. Patent application number
(The Patent Office will fill in this part)

0114501.0

14 JUN 2001

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

New Transducers Limited

37 Ixworth Place
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Patents ADP number *(if you know it)*

728347600 2

If the applicant is a corporate body, give the country/state of its incorporation

GB

4. Title of the invention

MOBILE TELEPHONE

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

MAGUIRE BOSS
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Cambridgeshire
PE27 5EB

Patents ADP number *(if you know it)*

07188725001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day/month/year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day/month/year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
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Description	10
Claims(s)	
Abstract	
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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature Maguire Boss Date 14/06/2001

MAGUIRE BOSS

12. Name and daytime telephone number of person to contact in the United Kingdom PETER MAGUIRE Tel: 01480 301588

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TITLE: MOBILE TELEPHONE

DESCRIPTION

The invention relates to a mobile telephone or cell phone and in particular, one which comprises a member (e.g. cover for buttons/display) which may be moved between an open and a closed position.

It is known from WO00/02417 to the present applicant to provide a mobile telephone or cell phone, comprising a display screen, a resonant panel-form member-form member, at least a portion of which is transparent and through which a display screen is visible, and vibration exciting means to cause the panel-form member-form member to resonate to act as an acoustic radiator or loudspeaker. The resonant bending wave panel-form member loudspeakers used may be of the kind

described in WO97/09842 (incorporated herein by reference), which are generally known as distributed mode loudspeakers.

For loudspeakers, such as those proposed in WO00/02417 to provide a broad acoustic output range, in particular, to provide an adequate low frequency response, it is necessary to mount a closed, shallow box behind the loudspeaker. The use of such a box is described in detail in WO99/52322 to the present applicant. The box adds unwanted bulk to such a loudspeaker unit and thus it is an object of the invention to provide a more compact loudspeaker unit, particularly for use with a flip lid mobile phone.

According to the invention there is provided a mobile telephone comprising a body and a bending wave loudspeaker which comprises a panel-form member capable of supporting bending waves and a transducer mounted to the panel-form member to excite bending wave vibration in the panel-form member to produce an acoustic output, characterised in that the body defines an open top cavity and in that the panel-form member is movable between a first and a second position with panel-form member covering the open top of the cavity when in the first position.

In the first position, the panel-form member closes a volume of air in the cavity which defines rear boundary conditions of the loudspeaker, the cavity may be designed so as to ensure the loudspeaker has a desired bandwidth by altering the rear boundary conditions. Thus, the problem of

providing a broad acoustic output range, in particular, of providing an adequate low frequency response without increasing the depth or bulk of the mobile phone, is solved by using the existing trapped air volume under the phone lid when in the closed condition.

In the second position, the panel-form member may be spaced away from the cavity and thus there may be an acoustic short circuit which reduces the bandwidth of the loudspeaker.

In effect, the cavity may be considered equivalent to the cavities or baffles described in WO99/52322 (incorporated herein by reference) and thus the cavity and the panel-form member may form a coupled system with coupled modes. The cavity may thus be considered as a shallow tray containing a fluid, e.g. air, whose surface may be considered to have wave-like behaviour and whose specific properties depend on both the fluid and the geometry of the cavity. The panel-form member is placed in coupled contact with the fluid surface and the wave excitation on a surface of the panel-form member excites the fluid. Conversely, the natural wave properties of the fluid interact with the panel-form member, so modifying the panel-form member's behaviour. Thus, the existing trapped air volume defines the rear boundary conditions of the loudspeaker. By adjusting these conditions, it is possible to allow the loudspeaker to have a given bandwidth at a particular distance.

The body may also be considered to act as a baffle for the loudspeaker in the first position since it prevent an acoustic short circuit between the front and rear panel acoustic output.

With the panel-form member in the first or closed position, the mobile phone may be used in hands free conference mode since the loudspeaker provides a broad bandwidth. With the panel-form member in the second or open position, the mobile phone may only be used effectively in handset mode, i.e. standard use by a user's ear. This is because in handset mode the close proximity of the panel-form member to a user's head provides a sufficient degree of self-baffling which reduces the effects of the acoustic short circuit and hence the loudspeaker may have adequate low frequency response and a broad bandwidth.

The cavity may be sealed by the aid of a resilient member disposed between the panel-form member and the body when the panel-form member is in the first position. The cavity may be sealed to prevent all radiation leaking from the cavity or to prevent radiation which has an acoustic resistance which affects the bandwidth of the loudspeaker leaking from the cavity. The resilient member may be a ring of foam or rubber. The resilient member may be mounted in a groove on the body of the phone or alternatively may be mounted around the edge of the lid.

The mobile phone may comprise a screen mounted in the body. The panel-form member may be transparent or alternatively may comprise a transparent portion whereby the screen may be viewed with the lid in the closed position. The transducer may be mounted at an edge of the panel-form member and may be spaced away from the transparent portion of the panel-form member so as not to obscure a user's view of the screen. When the panel-form member is edge driven, a narrow wall may be mounted to and project from a surface of the panel-form member. In this way, a simply supported boundary condition for the panel-form member is formed which may enable efficient use of the edge drive. The wall may also support the resilient member.

The transducer may be an inertial or grounded vibration transducer, actuator or exciter, e.g. moving coil transducer. Alternatively, the transducer may be a piezoelectric transducer and may be in the form of a strip of piezoelectric material. The transducer may be a bender or torsional transducer (e.g. of the type taught in WO00/13464). The transducer may be transparent.

The panel-form member is preferably mounted to the body via a hinge. The panel-form member may thus act as a lid or cover to a display screen, microphone and/or touch pad which may be mounted in the body. The loudspeaker may be a dual function loudspeaker and may act as both loudspeaker and microphone.

The bending wave loudspeaker may be a resonant bending wave mode loudspeaker of the kind described in WO 97/09842. In other words, the loudspeaker may comprise a resonant panel-form member and a transducer mounted to the panel-form member to cause the panel-form member-form member to resonate to act as an acoustic radiator.

The invention is diagrammatically illustrated, by way of example, in the accompanying drawings, in which:

Figure 1 is a side perspective view of a flip-lid mobile phone according to the present invention when the lid is closed;

Figure 2 is side perspective view of the mobile phone of Figure 1 when the lid is open;

Figures 3a and 3b are respectively plan and side views of the mobile phone of Figures 1 and 2 with the lid open, and

Figure 4 is a perspective view of a lid of a flip-lid mobile phone according to another aspect of the present invention.

In Figures 1, 2, 3a and 3b there is shown a mobile phone (10) comprising a body (12) and a member which is mounted to the body via a hinge (18). The member is moveable between a closed position in which the member covers the body (12) as shown in Figure 1 and an open position in which the member is at an angle of approximately 135° to the body (12) as shown in Figure 2. The mobile phone may also comprise a screen (22) which is covered by the member in the closed position

and thus the member may be considered to be a cover or a lid. The mobile phone also comprises a microphone (24) mounted in the body (12).

The lid is formed from a panel-form member (14) which is capable of supporting bending wave vibration, in particular, resonant bending wave modes. A transducer (24) is mounted to the panel-form member (14) to excite bending wave vibration in the panel-form member so as to form a bending wave loudspeaker, e.g. a resonant bending wave loudspeaker of the type known from WO97/09842, WO99/37121, WO99/52322, WO00/02417 and others to the present applicant.

The panel-form member (14) may be transparent or alternatively may comprise a transparent portion (26) as shown in Figure 3a. By using a transparent or partially transparent panel-form member (14), the optional screen (22) may be viewed with the lid in the closed position. Clearly, the screen will also be visible when the lid is open. As shown in Figure 3a, the transducer (24) is mounted at an edge of the panel-form member (14) and is spaced away from the transparent portion of the panel-form member (14) so as not to obscure a user's view of the screen (22).

The body (12) of the mobile phone (10) comprises an open top cavity (16) behind the optional screen (22). As shown more clearly in Figure 2, the cavity (16) is closed by the lid when the lid is in the closed position. The cavity is sealed in the closed position since the lid abuts against a

seal (20) in the form of a ring of foam or rubber which sits into a groove on the body of the phone.

The mobile phone has two modes of operation, namely hands free conference mode as shown in Figure 1 and handset mode, i.e. against a user's ear, as shown in Figure 2. In conference mode, the sealed cavity (16) defines the rear boundary conditions of the loudspeaker.

As shown in Figure 1 the lid is closed and the loudspeaker is effectively mounted in a closed, shallow box. The acoustic output from the panel-form member (14) is emitted in the direction of arrow S, namely from an upper surface of the panel-form member (14). In contrast, in Figure 2, the lid is open and thus the loudspeaker is spaced away from the cavity. Thus an acoustic short circuit is created which reduces the low frequency capability of the loudspeaker. However, when the mobile phone is used in handset mode, there is a sufficient degree of self-baffling to restore the required low frequencies. The useful acoustic output from the panel-form member (14) is emitted in the direction of arrow S, namely from a lower face of the panel-form member (14).

In Figure 4, there is shown a lid of a mobile phone which is similar to those shown in the previous Figures and thus items in common have the same reference numbers. The lid is formed from a panel-form member (14) to which a transducer (24) is mounted. A narrow wall (30) is mounted to and

surrounds a transparent portion (26) in the panel-form member. The wall is generally U-shaped with its short ends being attached to the hinge (18). The wall (30) may support the seal (not shown).

The panel-form member may be as taught in WO97/09842 and others to the present applicant, and thus the properties of the panel-form member may be chosen to distribute the resonant bending wave modes substantially evenly in frequency. In other words, the properties or parameters, e.g. size, thickness, shape, material etc., of the panel-form member may be chosen to smooth peaks in the frequency response caused by "bunching" or clustering of the modes. The resultant distribution of resonant bending wave modes may thus be such that there are substantially minimal clusterings and disparities of spacing.

In particular, the properties of the panel-form member may be chosen to distribute the lower frequency resonant bending wave modes substantially evenly in frequency. The number of resonant bending wave modes is less at lower frequency than at higher frequency and thus the distribution of the lower frequency resonant bending wave modes is particularly important. The lower frequency resonant bending wave modes are preferably the ten to twenty lowest frequency resonant bending wave modes of the acoustic radiator. The resonant bending wave modes associated with each conceptual axis of the panel-form member may be arranged to be

interleaved in frequency. Each conceptual axis has an associated lowest fundamental frequency (conceptual frequency) and higher modes at spaced frequencies. By interleaving the modes associated with each axis, the substantially even distribution may be achieved. There may be two conceptual axes and the axes may be symmetry axes.

The transducer location may be chosen to couple substantially evenly to the resonant bending wave modes. In particular, the transducer location may be chosen to couple substantially evenly to lower frequency resonant bending wave modes. In other words, the transducer may be mounted at a location spaced away from nodes (or dead spots) of as many lower frequency resonant modes as possible. Thus the transducer may be at a location where the number of vibrationally active resonance anti-nodes is relatively high and conversely the number of resonance nodes is relatively low.

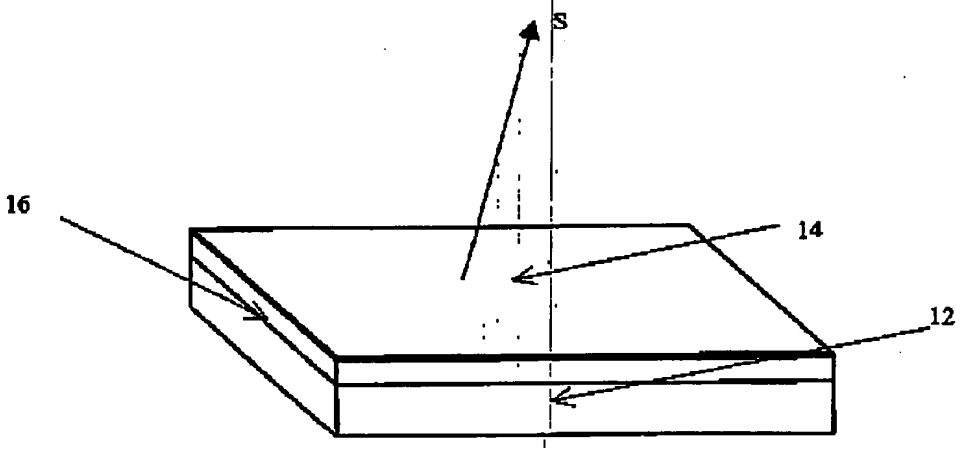

Fig 1

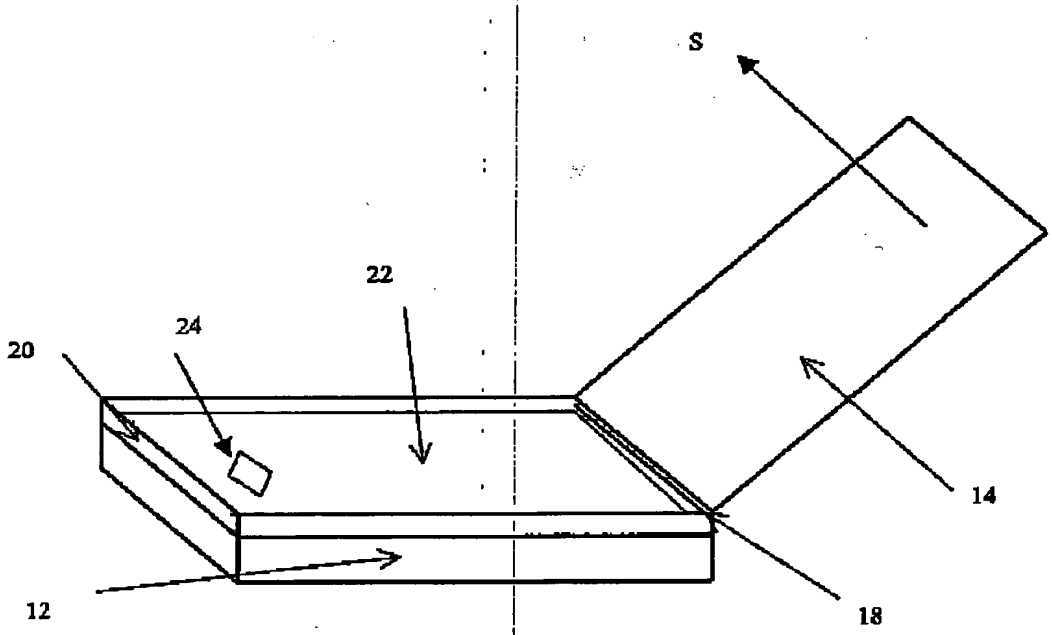

Fig 2

Fig 3a

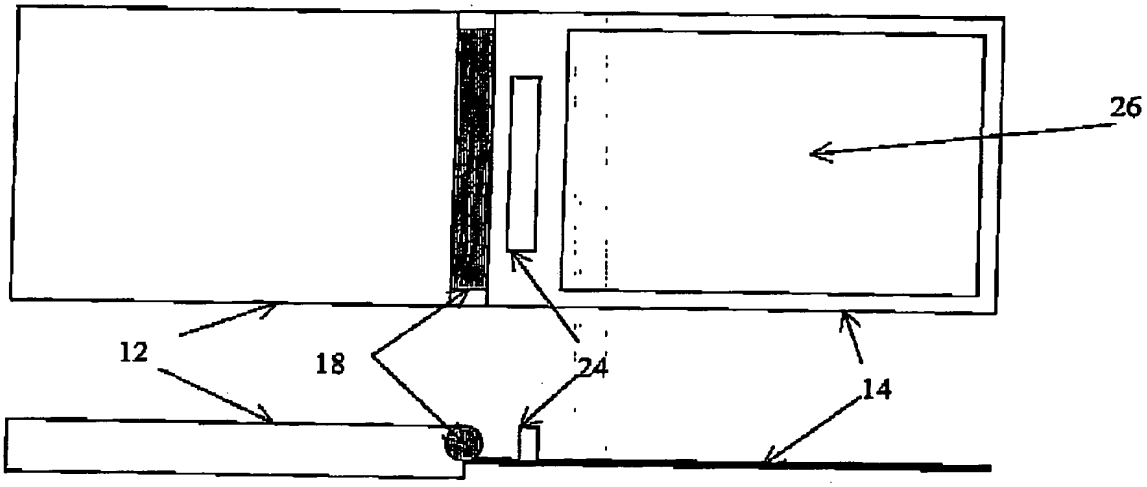

Fig 3b

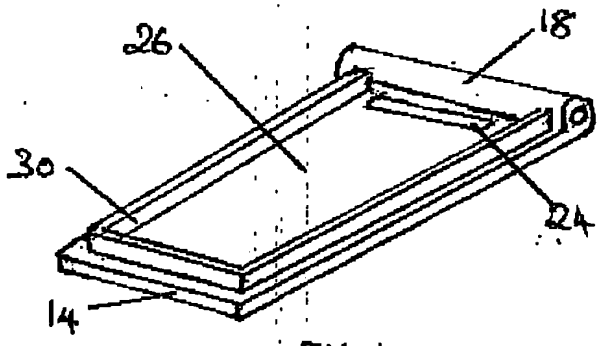

FIG 4

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